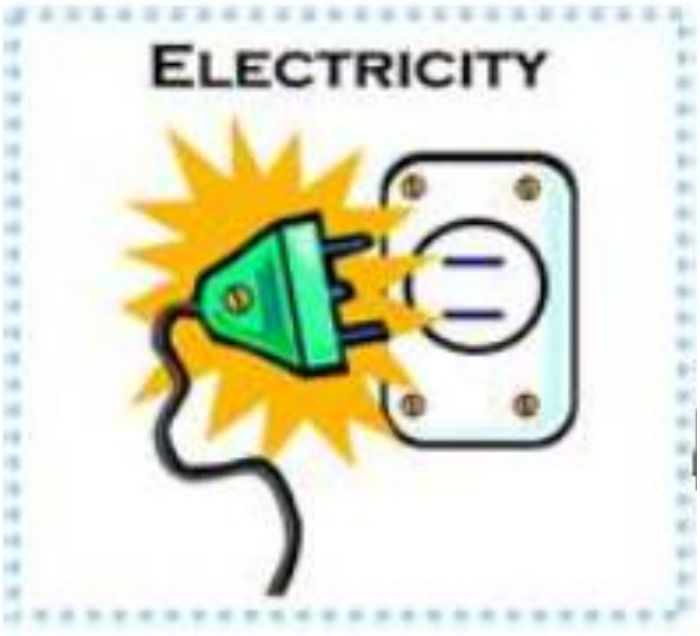
Mc CAIG ELEMENTARY SCHOOL

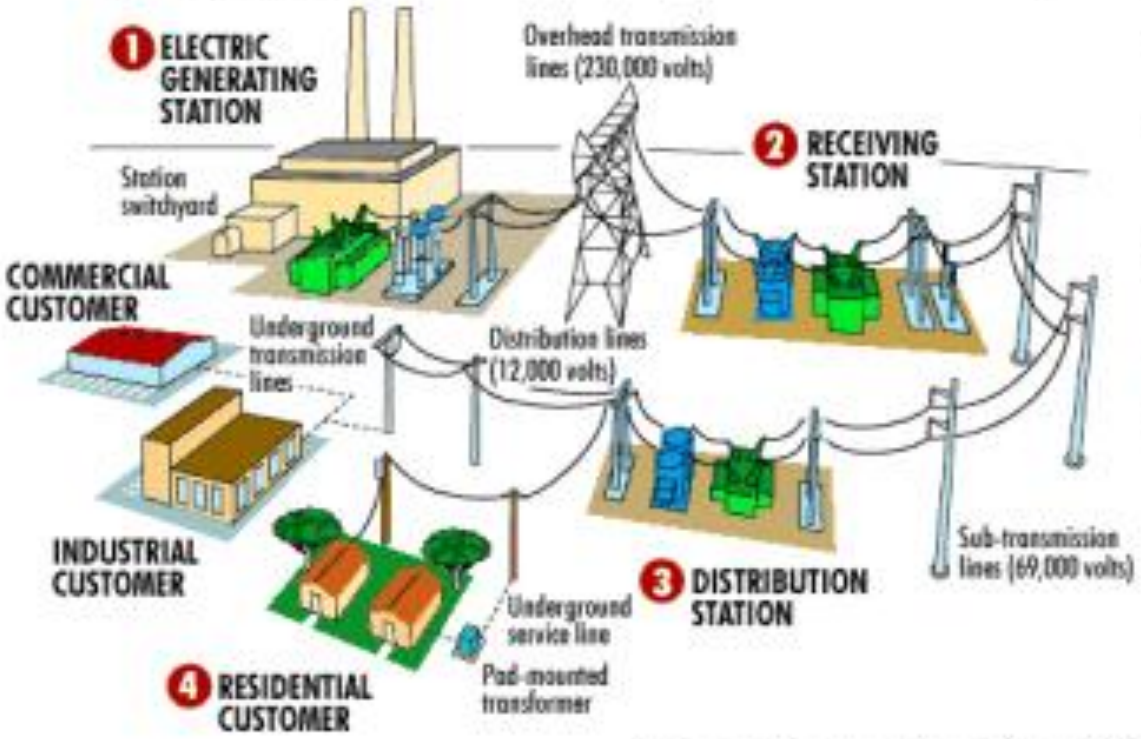


SCIENCE

CYCLE 3

CURRENT ELECTRICITY

STUDENT: _____



Teacher: Mr. D. Strine

CURRENT ELECTRICITY
from the series *Electricity and Magnetism*

I. Directions: Pick the definition in column B that best matches the word in column A. Write the letter of the definition on the blank line.

A	B
1. current electricity _____	a. Something that lets electrons flow easily through it.
2. circuit _____	b. Can start a fire or cause other problems because electricity can escape from its path.
3. conductor _____	c. Something that stops the flow of electrons.
4. insulator _____	d. Electrons that are moving.
5. switch _____	e. Protects buildings from overloading circuits and fires.
6. short circuit _____	f. Something that can control the flow of electricity through a circuit.
7. circuit breaker _____	g. Made up of three main parts: a source of electrons, an object to use the electricity, and a path.

II. Directions: The following questions need a short answer.

1. Describe how a series and a parallel circuit are different from each other.

2. Why is a parallel circuit used in household wiring?

3. Why are certain metals, such as copper, silver, and gold, good conductors of electricity?

CURRENT ELECTRICITY
from the series *Electricity and Magnetism*

Directions: At the end of the program, there is a short quiz. You can record your answers on this sheet.

1. Current electricity is _____.
    a. a conductor
    b. an insulator
    c. the flow of electrons
    d. a closed circuit

2. A complete circuit is made of three things:
    a. An insulator, a source of electrons, and a path.
    b. A conductor, a source of electrons, and a path.
    c. A switch, a source of electrons, and a path.
    d. Something to use the electricity, a source of electrons, and a path.

3. Something that allows electrons to flow easily through it is called _____.
    a. an insulator
    b. a conductor
    c. a switch
    d. a current

4. Something that slows the flow of electrons is called _____.
    a. an insulator
    b. a conductor
    c. a switch
    d. a current

5. There are two types of circuits: _____.
    a. insulators and conductors
    b. closed and open
    c. series and parallel
    d. switch and current

CIRCUITS

An electric circuit must have three things to be complete. There must be a supply of electrons, something to use the electricity, and a path on which the electrons travel. There are two kinds of circuits—parallel and series.

Purpose: To compare a parallel circuit with a series circuit.

Materials: four 1-1/2 volt light bulbs and sockets
three 1-1/2 volt dry cells
insulated wire

Procedures:1. Refer to the diagrams and build parallel and series circuits.

Observations:

1. What happens when you loosen one of the light bulbs in the parallel set-up?

2. What happens when you loosen one of the bulbs in the series set-up?

Conclusions: Explain why there are different results in your observations.

Directions: Answer the following questions in the space provided.

1. What three things are needed for a complete circuit?

2. What is a conductor?

3. What is an insulator?

4. What is a series circuit?

5. What is a parallel circuit?

6. How does a circuit breaker protect a home?

7. Why are parallel circuits used in homes instead of series circuits?

8. What is a short circuit?

9. What is current electricity?

10. Draw a parallel circuit to connect these two bulbs with the dry cell.

I. Directions: Pick the definition in column B that best matches the word in column A. Write the letter of the definition on the blank line.

Column A	Column B
1. electricity _____	a. When two objects come toward each other.
2. conductor _____	b. The Greek philosopher who named electricity.
3. insulator _____	c. A positively charged particle found in the nucleus of an atom.
4. attract _____	d. The flow of electrons.
5. repel _____	e. An atomic particle found in the center of an atom. It has no charge.
6. electron _____	f. Material that will not allow the flow of electricity.
7. proton _____	g. A particle found orbiting around the nucleus of an atom. It has a negative charge.
8. neutron _____	h. Material that allows electricity to go easily through it.
9. Thales _____	i. When two objects move apart.

II. Directions: Answer the following questions in the space provided.

1. Name three good conductors of electricity.

2. Name three good insulators.

3. Describe some uses for insulators.

4. How does a generator work?

5. Describe how a simple electromagnet could be made.

6. How is an electromagnet different from a regular bar magnet?

7. What three things are needed for a complete circuit?

8. There are two kinds of circuits: series and parallel. Finish the drawings below by adding wires.

9. What are the differences between a series circuit and a parallel circuit?

10. How do fuses or circuit breakers help protect homes?

11. Mechanical energy of the spinning turbine and generator produce electrical energy at a power station. Give some examples of electrical energy being changed to other forms of energy around your home.

12. Fossil fuels (oil, coal, and natural gas) are the main sources of fuels used to power the electric plants of today. What are some other sources of energy that can be used to make electricity?

13. If these two magnets were to be brought near each other, how would the lines of force look?

14. If one of the magnets was flipped over, how would the lines of force be changed?

15. Amperage is equal to wattage divided by voltage. Calculate the number of amps for each of these electrical appliances.

a. electric toothbrush	480 watts	120 volts	_____ amps
b. electric blender	960 watts	120 volts	_____amps
c. microwave	720 watts	120 volts	_____amps

There are two types of electricity, static and current.

Current electricity is the flow of electrical charge. To move from one place to another, current electricity needs what is called a complete circuit. The circuit is made up of three things.

There must be a source of electrons, something to use the electrons, and a path for the electrons to travel along to go to the device and back to the source. Here is a simple circuit that is made up of a battery, some wire, and a light bulb. When the path for the electrons to travel along is complete then the bulb will light. This is called a closed circuit. There are no breaks, or gaps, in the circuit. When there is a break in the circuit, it is called an open circuit. The path isn't complete and the electrons can't flow.

For the circuit to work, there must be wires that will conduct electricity as part of the path. Conductors are substances that allow electricity to flow through them easily.

You can make a conductor detector with a battery, light bulb, and some wire. Test some things that you think might conduct electricity. Copper is an excellent conductor; that's why most wire is made from copper. Zinc is a good conductor and so are silver and gold. In fact, silver and gold are excellent conductors of electricity, better than copper and zinc.

Expensive audio and video equipment often uses gold-plated cables and plugs because gold is such a good conductor.

Other things aren't good conductors. They are called insulators, which means they resist, or stop, the flow of electricity. Wood is an insulator and so is plastic. Wires have plastic coatings that help keep the current from moving out of the wire.

Some insulators are used in electrical devices such as this toaster oven. The wire that turns red and heats the food is resisting the flow of electrons, and, as a result, it is heating up. This wire is used to specifically cook the food.

You may wonder why zinc, copper, and gold are such good conductors.

Let's look at the periodic table of elements to find the answer. Notice that the three metals we are talking about are located here on the table. To see why these metals are good conductors, we need to look at their atomic structure.

Let's look at copper first. Copper is element 29, which means it has 29 protons and 29 electrons in each atom.

Electrons are found in orbit around the nucleus of an atom. The nucleus is made up of protons and neutrons.

The electrons in orbit will fill up orbital shells. These shells are specific distances from the nucleus. Each shell can hold a certain number of electrons. The first shell can hold two electrons and the next shell can hold eight electrons. That makes ten electrons so far. The next shell can hold as many as 18 electrons. So the total electrons in the first three shells comes to 28, which leaves one electron left in the copper atom. That lone electron will be by itself in the fourth electron shell. Because it is all by itself, it is easily bumped out of orbit if another free electron comes near by and repels it. This repulsion happens because the two electrons each have a negative charge.

Zinc is a good conductor because it is element number 30. It has thirty electrons and therefore, two electrons in the fourth shell. These two electrons are loosely held.

Silver is element 47. It has 47 electrons: two in the first shell, eight in the second shell, eighteen in the third shell, eighteen in the fourth shell for a total of 46 electrons. That leaves one electron in the fifth shell. Yes, it is a loosely held electron.

SERIES AND PARALLEL

There are two kinds of circuits. One is called a series circuit and the other is called a parallel circuit. Let's look at a series circuit first.

Here is a simple series circuit that is made up of a source of electrons, something to use the electrons, and a path for the electrons to travel along. We can add another bulb to the series circuit and both will light up. Notice however, that they are dimmer than the one bulb by itself. Now watch what happens when we unscrew one bulb and cause a break in the circuit path. Both lights go out. For the series circuit to work, everything must be connected without any breaks, or gaps, in the circuit.

The parallel circuit is set up differently. There are additional pieces of wire used to connect the two bulbs. This time, when the bulb in one holder is loosened, only that bulb turns off. The other light stays on. This happens because there is more than one path for the electrons to travel along. This is called a parallel circuit because the wires form parallel lines. If one path is interrupted, there is still another path for the electrons to travel along.

Which type of circuit would you guess is used in common household circuits? Well, if you said a parallel circuit, you're right. If household circuits were built in series, then the television would go off when the light bulb burns out. However, because that doesn't happen, we know that parallel circuits are used.

A switch can be very helpful in a circuit. The switch can control when electrons will flow. When the switch is closed, the circuit is complete and electricity flows. When the switch is open, the flow of electricity stops.

CIRCUIT BOX

Circuits in a house, store, or school must be protected. They must be protected from overheating. Circuit boxes are used to provide this protection. When the electrical lines come into the building, they go to the circuit box. The box splits the main line into several smaller circuits. Each circuit is capable of carrying a certain flow of electrons.

If too many things are plugged into a circuit and they are all being used at the same time, it may cause a problem. As more and more current is sent through the circuit, the wires begin to get hot and will possibly start a fire. So to protect against this happening, the circuit is tripped. That means the path is interrupted and the flow of electrons stops. Many people get mad when this happens, but they should actually be happy because it means the circuit breaker is doing its job and preventing a possible fire.

To get the circuit working again, you should unplug and turn off some of the things plugged into the circuit and then the circuit breaker can be flipped back on.

In many bathrooms and kitchens, you will find a special outlet called a ground fault circuit interrupter, or GFCI. This outlet works like a circuit breaker in a circuit box to protect us from electrical shock. It constantly compares the current in one side of the outlet with the current in the other side. If there is a difference, it opens the circuit so electricity stops flowing. To regain use of the outlet, you must push in the reset button.

SUMMARY

Today we have taken a look at current electricity. Electricity is the flow of electrons. There are two types of electricity: static and current. Static electricity is electricity that builds up on an object and remains on that object until there is a place for it to go. Lightning is an example of static electricity. Current electricity is the flow of a charge through a conductor. Current electricity is the electricity we use to run things at home, school, and at work.

Current electricity is generated at huge power plants and sent to our homes. Or we buy some batteries at the store and use them to power our toys and utensils. For electricity to flow, there must be what is called a complete circuit. That means there must be a supply of electrons, a path for the electrons to travel along, and something to use the electrons. The circuit must be complete, or closed, for the electrons to move. If the circuit is open, then electrons can't flow through the circuit.

There are two different kinds of circuits. They are called series and parallel. A series circuit has one path for the electrons to travel along, so if something in the path becomes burned out or disconnected, the entire circuit is affected. A parallel circuit has parallel wires for the electricity to flow through, so if one light burns out, the others stay lit. It takes more wire to make a parallel circuit, but it is worth it to avoid having a circuit fail because of one bulb or appliance going out.

Electricity is one of our most important forms of energy. Our lives are greatly affected when electricity isn't available or for some reason stopped.

THOMAS EDISON AND THE LIGHTBULB

One of the greatest inventors of all time was Thomas Edison. He established the first industrial research laboratory in world history. He built a two-story lab and additional buildings to house teams of craftsmen and tools to carry on scientific investigations and research. He brought together craftsmen in a wide variety of fields, from glass blowers to machinists and from chemists to mathematicians.

Thomas Edison and his team came up with many inventions that have had a great impact on the world. They are responsible for the phonograph, movie projector, improvements on the telephone, and telegraph. In fact, Edison had 1,093 patents by the time he died. He and his team of researchers at Menlo Park averaged a new patent or invention every eleven days.

Edison didn't invent the incandescent bulb, but he did develop the first successful light bulb. This is often considered his most important contribution. The main problem was finding a material that could be used as a filament. Incandescent bulbs make light by using electricity to heat a thin strip of material so hot that it glows. They needed something that would resist the flow of electrons and glow. But finding a material that would do that and not burn up was a very hard task. They tried grass, hair, and all kinds of fibers coated with different chemicals. No one knows for sure how many things Edison tried before discovering that bristol board, which is a kind of thin cardboard, coated with carbon would work. However, when asked, Edison admitted that he knew of fourteen thousand ways not to make a light bulb.

Edison powered his light bulbs with wet and dry cells and eventually a generator.

Here is one of the first houses equipped with Edison's light bulb. He set up many of the buildings and this home on the grounds of Menlo Park, his research center, with lights and electricity for a demonstration of this new invention. Notice how the wires are exposed and travel along the ceiling. Also, notice the wood used as supports and insulators.

Not long after this demonstration, Edison built the first power plant. He wired a block with electric lights in New York City. Edison's system included dynamos, switches, electric meters, fuses, distribution lines, and regulators. He didn't invent the incandescent light bulb, but he was the first person to make one that worked. His breakthrough with the electric light led to all the wonderful uses we make of electricity today.